BROOKLYN BOTANIC GARDEN

# LEAFLETS

SERIES VIII | BROOKLYN, N. Y., APRIL 7, 1920. | No. 1

## REAL TESTS

"Why do you come to the Botanic Garden?" was asked of a ten-year old boy this summer by a member of Dr. Jean Broadhurst's class in Nature Study. Dr. Broadhurst, of Columbia University, always brings her summer school class to see the work done for children at the Brooklyn Botanic Garden. Each year she asks the members of her class to find out, if possible, why our 320 children come to the Botanic Garden, and so this small boy was asked why he was here. The young woman afterwards said that the boy straightened himself up, thought a moment, and then replied: "I am here for three reasons; first, for elementary instruction; second, because I like it; and third, because I get a crop." This boy's reply was so good and so comprehensive that it would almost seem as if he had been primed and cocked for this answer; but not so.

In the first place, every boy and girl who comes to the Botanic Garden knows that his instruction is in the line of elementary education. The present age and stage in education is such that we hear a great deal about scientific tests, the Binet Tests, the Otis Tests, etc.—all the tests which are being applied to the student to find out his mental and physical ability. The results of these tests are sometimes overwhelming. There must come a feeling that no educational test, no physical test, can adequately guage the real ability of a young person. Something falls in between, and that something is what might be summed up under the head of results from life tests. The answer of the small boy applies to the life test. First, in any department of work a child must receive a certain body of knowledge—summed up by this child as "elementary instruction." Second, he must be able to use practically that body of knowledge, summed up in the child's third answer; and lastly, he must be able to enjoy whatsoever he is doing. Enjoyment is one of the basic principles of life. Without it no work carries over. It is difficult to arrange in an orderly

way for our life tests. The Binet Tests, with their too accurate data, almost put these life tests of ours to shame.

How then, is one to check up a piece of work such as is being done at the Brooklyn Botanic Garden for boys and girls? In the first place, it is possible all the time by incidental questions, not by mere formal examination, to find out whether or not the child has absorbed the body of knowledge which one has planned for his special needs. How is it ever possible to find out whether or not anyone is able to put knowledge into everyday practice? That has always been a puzzling problem. We hear a great deal to-day about project work, and about training for good citizenship. Almost every good teacher, from time immemorial, has been training his students for good citizenship and has been giving project work. During the six years the boys and girls have been working at the Botanic Garden, certain pieces of work have been presented to them, which I suppose would go under the heading of project work, and which check up the body of knowledge these boys and girls have.

For example, during last summer we faced a serious problem in our garden. Three hundred and twenty boys and girls were to garden for six months. Three hundred and twenty boys and girls must have lessons and must be cared for. How was this to work out? Our trained help was too few in number. Out of the 320 children about thirty boys and girls had been at the Botanic Garden from three to five years. Should it not be possible for those boys and girls to be used, to put the knowledge they had gained into practice? So each one was presented with a given number of children, according to his talents, and each was responsible for these young children, not only in garden work, but in garden behaviour, because one of the most valuable lessons taught in the garden is that of the right attitude toward our children's garden and the Botanic Garden as an institution and toward life in general. These boys and girls were not given a certain block of the garden to look out for. The individual children were placed all over the garden, so that there should be no spots too weak and no situations too entertaining. It was amazing to see the amount of real good work done by these boys and girls of approximately fifteen years of age. They taught the children with great pains, and perhaps with more labor than a grown person would have given to the individual, and the children responded with perhaps greater delight to these youthful teachers than they would have to the trained teachers. Of course, all the time these boys and girls were supervised by trained people, although the supervision was planned to be so apparently casual that they never knew of this check-up. This is an illustration of how one may test out the knowledge of a child.


TESTING GARDEN SEEDS.

Another example: at the present time a high school senior has a class of four small boys twice a week. This young lad, with his four helpers, is preparing cuttings of all sorts of plants, so that our greenhouses may offer rich opportunities for other boys and girls. His work, he distinctly understands, is to train those others into useful people who can do independent work. No work is truly successful until out of it comes an independence of thought and action.

The enjoyment test is evident on the face of things. We either like or we do not like that piece of work which is apportioned to us in this life. A wonderful lesson is learned when it is possible for a child to pick up whatever task comes to him and be able to feel that he is going to be able to enjoy that special thing. This sounds like enjoyment with a big stick held over it, but it is not so. When work may be entered upon because we want to do it, and when, if it is not entered upon, some one else is bound to want to do it, immediately the problem of enjoyment is solved. Psychologically we should arrange our work so that young people are standing on tiptoe with eagerness to be a part of any given work. It is understood by all boys and girls who come here that there are many, many other boys and girls waiting—just waiting for them to drop out and give the others a chance. You could not possibly drop out under such conditions!

Work planned for children should always be planned with a definite thought that it is important. We have no business to be placing before our young people, in this time of the world, any work that is not very seriously important; and there is nothing in the world more important than to learn how to live happily and wisely. There is no finer tribute to work than the boy's reply, "I am here because I like to be here."

Ellen Eddy Shaw.

BROOKLYN BOTANIC GARDEN

# LEAFLETS

SERIES VIII BROOKLYN, N.Y., APRIL 14, 1920. NO. 2

## THE SEVENTH ANNUAL GARDEN EXHIBIT FOR BROOKLYN BOYS AND GIRLS

**Time**—The seventh annual Garden Exhibit for boys and girls of Brooklyn will be held September 17 and 18. Note that September 17 falls on a Friday. We planned this. Why? So your teachers could bring your class in school time, if your principal is willing. Isn't that good? The exhibit will be open on these exhibit days from 10 a. m. to 4 p. m.

**Place**—Our exhibit will be held in the central rotunda of the laboratory building, at the Botanic Garden. The building may be entered either from Washington Avenue, No. 978, or from the Garden side.

**Conditions of Entry**—Be sure that each separate exhibit, unless it be a part of the class or school exhibit, has an entry card with the exhibitor's name, school, and address upon it. These entry cards may be had from us in early September, and should be filled in exactly as indicated. Bring the exhibits to the Botanic Garden on September 16, between 9 a. m. and 3 p. m.

**Time of Judging**—Three expert judges will judge these exhibits and make public their decisions on September 17, at 10 a. m.

**Prizes**—1. *Individual.* These prizes are, as heretofore, silver medals as FIRST, and bronze medals as SECOND PRIZES.

2. *Groups.* Prizes in *Classes A*, *B* and *C* are won by groups of boy and girls working together. The FIRST PRIZE in *Class A* is a trophy won by P. S. 89 last year, and by P. S. 98 for the two years before that. If P. S. 98 wins this in the 1920 exhibit it will be theirs to retain always. The SECOND PRIZE is a silver cup. FIRST and SECOND PRIZES in *Class B* will be silver cups, which remain, when won, as the permanent property of the school or association. *Class C* has, as a FIRST PRIZE, a bronze statue of Victory. This was won by P. S. 49 in 1919. One school, winning this statue three times, is entited to it. The SECOND PRIZE will be a silver cup.

**Removal of Exhibits**—Exhibits may be taken away by the exhibitors at 4 p. m. on September 18, or at any time before the 22nd.

**Presentation of Prizes**—Prizes, both individual and group, will be presented on October 2, at 2:30 p. m., in the auditorium of the

Brooklyn Botanic Garden building. No prize winner will receive his prize unless he presents or sends a substitute on October 2.

**To be Noted**—Read over instructions concerning *Class K*. To enter this contest, apply at once by letter or otherwise on or before July 1 to the Curator of Elementary Instruction, at the Brooklyn Botanic Garden. An enrollment card will be sent to you. These prize gardens will be visited during the summer. For the prizes in this class and the conditions for entry read under instructions of *Class K*.

**To be Specially Noted**—The Alfred T. White Scholarship. What is it? A college scholarship of $100 for the boy or girl working at least two seasons at the Brooklyn Botanic Garden and showing marked ability in High School biology. When will it be given? For the first time in 1920 and annually thereafter. How can I become a candidate for the Alfred T. White Scholarship? By applying at once to the Brooklyn Botanic Garden and then keeping busy with your hoe, and your biology books, and by your efforts toward being an all-around good young citizen of the Borough of Brooklyn.

CLASS A—**School Display.** FIRST PRIZE, a trophy to the school making the best display, to be held for a year only, or until won three times, when it becomes the permanent property of the winning school. SECOND PRIZE, a silver cup. This year we want some new schools to try for this. See if this year your school cannot send in the best collection of vegetables, flowers and plants. These may be raised either at schools or in home gardens.

CLASS B—**Community Garden Display.** *Class B* differs from *Class A* in several respects. In the first place, *Class A* must be the work of a school, either supervised or non-supervised work. It usually is the latter. *Class B*, the Community Garden Display, is represented by those schools having instructions throughout the summer—for example, school gardens under the supervision of the Board of Education, gardens under the supervision of the Park Department, or community gardens under the supervision of a paid instructor. The FIRST PRIZE in this exhibit is a silver cup; the SECOND PRIZE a silver cup.

CLASS C—**Box Display.** This display will consist of plants and flowers in boxes, and of potted plants. There are schools where it is impossible to have a school garden, and where the neighborhood is such that it is impossible to have home gardens; for such this class is added. The FIRST PRIZE in this exhibit is a bronze statue of Victory which shall be competed for under the same conditions as those for the trophy in *Class A*. SECOND PRIZE is a silver cup.

CLASS D—**Flowers.** This is a class for individual competition, and in which first and second prizes are offered. In this and the following classes the FIRST PRIZES are silver medals; SECOND PRIZES, bronze medals. Certificates of honorable mention will also

be awarded. If a boy or girl enters an individual class, he must understand that these same products cannot count toward his school display. Double entries should be made in such cases. Do not forget this. If you enter zinnias for an individual prize and wish to add zinnias to the school display, then you must bring two bunches of zinnias. The divisions in *Class D* are as follows:

No. 1. Ageratum
Best 4 sprays

No. 2. Alyssum
Best plant (potted)

No. 3. Asters, blue
Best collection of 10

No. 4. Asters, pink
Best collection of 10

No. 5. Asters, white
Best collection of 10

No. 6. Asters, mixed
Best collection of 12

No. 7. Asters
Best plant (potted)

No. 8. Calendula
Best collection of 8

No. 9. Cornflower
Best collection of 12

No. 10. Dianthus
Best collection of 10

No. 11. Marigold
(Giant African)
Best collection of 12

No. 12. Marigold
(Dwarf French)
Best collection of 12

No. 13. Marigold
Best plant (potted)

No. 14. Nasturtium
Best collection of 12

No. 15. Phlox
Best collection of 8

No. 16. Sunflower
Largest flower

No. 17. Verbena
Best collection of 10

No. 18. Zinnia
Best collection of 10

CLASS E—**Vegetables.** Surely this ought to be a popular class this year. Plan ahead so your vegetables will be in their prime at exhibit time. Try to send in perfect specimens. If, for exemple, you are exhibiting under No. 17, red tomatoes, have your eight tomatoes as near the same size as possible. Wash your vegetables carefully, so that they make an attractive appearance. FIRST PRIZES in this class are silver medals; SECOND PRIZES, bronze medals; THIRD PRIZES, certificates of honorable mention.

DIVISIONS IN CLASS E

No. 1. Beans, bush
Best pint, shelled

No. 2. Beans
Best quart, unshelled

No. 3. Beets
Best bunch of 6

No. 4. Carrots
Best bunch of 5

No. 5. Cabbage
Best head

No. 6. Corn
Best 6 ears

No. 7. Egg-plant
Best 2

No. 8. Kohlrabi
Best 4

No. 9. Lettuce
Best 2 heads
(roots and all)

No. 10. Onions
Best 4

No. 11. Peppers
Best 4

No. 12. Potatoes
Best 6

No. 13. Pumpkin
Best specimen

No. 14. Radishes
Best 8

No. 15. Squash
Best specimen

No. 16. Tomatoes, green
Best 8

No. 17. Tomatoes, red
Best 8

No. 18. Tomatoes
Small-fruited varieties
Best 10

CLASS F—**Best Special Plant.** Any plant cared for by the exhibitor may be entered. The plant may be a geranium raised from a cutting, an aster from a seed, a fern from a runner—it matters not so long as the work is yours. The plant stands no chance of prize winning if it is not in good condition, clean, properly potted, and free from insect pests. FIRST PRIZE, a silver medal; SECOND PRIZE, a bronze medal; THIRD PRIZE, a certificate of honorable mention.

CLASS G—**Best Bunch of Flowers.** Judged on perfection of the flowers and taste in arrangement. FIRST PRIZE in this class is a silver medal; SECOND PRIZE, a bronze medal; THIRD PRIZE, a certificate of honorable mention.

CLASS H—**Individual Garden Display.** The greatest variety of flowers or vegetables raised by one child constitutes this display. Here is an opportunity to show some originality and taste in the way you put together and arrange your own exhibit. Let us have more exhibits in this class this year. FIRST PRIZE, a silver prize; SECOND PRIZE, a bronze medal; THIRD PRIZE, a certificate of honorable mention.

CLASS I—**Weed Display.** This weed exhibit may be one of either fresh or pressed specimens. No exhibit can take a prize unless the specimens are carefully and correctly named. If you go away to the country in the summer you will have a good opportunity to make a large collection of weeds and wild flowers for the exhibit. FIRST PRIZE is a silver medal; SECOND PRIZE, a bronze medal; and certificates of honorable mention will be awarded to those taking third places.

CLASS J—**Wild Flowers.** Similar to *Class I.* FIRST PRIZE, a silver medal; SECOND PRIZE, a bronze medal; THIRD PRIZE, certificates of honorable mention.

CLASS K (*a*)—**Back Yard Gardens.** Boys: $15.00 IN WAR SAVINGS STAMPS will be presented to the boy having the best back yard garden in Brooklyn. $10.00 in WAR SAVINGS STAMPS will be given to the boy having the second best back yard garden. Conditions for these prizes are as follows: First, the garden must be kept by the applicant; second, the garden must be at least 10x20; third, plans, diagram, costs of seed, amount of crop must be all submitted in writing to the Botanic Garden at the time of the exhibit. These gardens must be entered in this contest by July 1st, and will be visited at least twice during the season by a judge from the Botanic Garden.

CLASS K (*b*)—Same for girls as *Class K* (a).

ELLEN EDDY SHAW,
Curator of Elementary Instruction.

BROOKLYN BOTANIC GARDEN

# LEAFLETS

SERIES VIII BROOKLYN, N. Y., APRIL 28, 1920. No. 3

## THE ANCIENT HISTORY OF PLANTS*

The earth has been estimated to be anywhere from 25,000,000 to 400,000,000 years old. Man, in all probability, appeared upon it between two thousand and three thousand centuries ago. The historic record, as deciphered from the remains of ancient civilizations, possibly extends back seven to eight thousand years. This record, contrasted with the age of the earth (conservatively estimated as 120,000,000 years), is as a quarter-second is to the passing of an hour, or, as some one has more graphically put it, "as the flashing of a meteor through the sea of night." The oldest known plant remains are probably less than half the earth's age, but antedate man by millions of years. The earliest vegetation which the rocks have shown us in any quantity, is far from simple in type, most of the forms being trees, shrubs, or woody ferns. Immense layers of rock strata still older than these exist, however, from which only the merest vestiges of plants have been taken. Hence, grounds exist for supposing these plants to have been already many stage-journeys along the road of evolutionary progress. Already they had an eon-old ancestral tree.

During those first ages when the earth's crust was forming, land was scarce, and the seas were new and filled with fresh water. Hence, the first plants were sea-born, distant relatives of our present-day pond-scums and slimes. As the centuries passed, land increased. Innumerable rivers filled the seas with decomposed mineral matter. They lost their freshness. Only the more adaptable of the earlier vegetation remained, while the less adapted types existed only in the fresh-water areas of the slowly appearing continents. From the former, perhaps, came our present-day seaweeds; from the latter, our fresh-water green scums and slimes. Between the seaweeds, so far as the rock-written pages testify, and the rest of the plant kingdom, a great gulf exists—an almost entire absence of connecting links. A very few petrified moss and liverwort fragments have been found, but these furnish practically no clue as to their ancestral relations, either to the pond-scums and seaweeds on the one hand, or to the ferns, conifers and flowering plants on the other.

Mosses and seaweeds being rather delicate plants with no woody parts, the comparative scarcity of their petrified remains is rather to be expected. First, because only a relatively small portion of these most ancient plant graveyards have been explored and only vegetation most favorably placed has been preserved. Second, since the earliest types of vegetation arose, the land and sea areas which they inhabited have undergone great alterations. The earth's crust has been repeatedly crumpled into mountain ranges and grooved into valleys, only to be rumpled and creased anew. Mountain chains have risen, only to sink and

*This is largely a revised reprint of LEAFLET No. 14, Series IV.

rise again. Seas have receded in many places and encroached on the land in others. Lakes have been cut out and rivers formed to carry off their surplus waters. Great oceans of ice have swept down from the north, levelling hills, cutting valleys, and moving thousands of tons of rock and soil. It is hardly necessary to state what would become of fragile plant remains amid such turmoil.

Hence, the rock-written story of the evolution of plants is largely concerned with those having woody stems — in other words, horsetails, conifers, and flowering plants. As to the primitive ancestors of these already complex types, we can only speculate. As to whether the mosses and liverworts are an offshoot from the main ancestral trunk which terminated in our flowering plants, a distinct section of it, or a backstep from some fern type, can be more definitely discussed only when the rocks have given up more of their facts—when the plant graves have given up more of their dead.

If the rock strata of the earth's crust had undergone no volcanic or other serious disturbance during the time it was laid down, one might visualize a section through it as a slice cut from a huge cake composed of many layers, each layer differing somewhat in composition and texture from the one beneath it. But earthquakes, volcanic activity, and other alterating forces have distorted, upheaved, and otherwise played havoc with the regularity of these layers until even a geologist has his troubles in correctly identifying their different outcroppings. These layers being laid down in sequence, the bottom one is naturally the most ancient, as well as the hardest to investigate. In order to make them easier to study, many layers are grouped together, and the time in which they were laid down is called an era. These eras are again subdivided into periods, etc. The three main divisions, or eras, are generally known as the Paleozoic, Mesozoic, and Cenozoic, the latter taking in the present time.

Certain kinds of plants were most plentiful and formed the predominant flora of each of these divisions. Hence they are often known respectively as the age of pond-scums, seaweeds, primitive seed-plants, ferns, club-mosses, and horsetails; the age of conifers, cycads, and ginkgos; the age of flowering plants* (our own age). Beneath the Paleozoic rocks lie immense thicknesses of other rocks, the pre-Cambrian, almost if not entirely devoid of fossil remains, hence as yet contributing nothing to the story of plant life.

In fact, the first beginnings of the imperfectly connected history of the world's flora, past and present, is found high up in the rocks of the Paleozoic era, an era perhaps as long as or longer than the two succeeding ones combined. Here, over midway through this immense deposit, lie imbedded the remains of countless forests—forests of a far different aspect and relationship than the hardwood and conifer forests of to-day. Here lie the known remains of at least two or three great branches of the ancestral tree of our plant world—the ferns; the club-mosses, horsetails and their relatives, and the groups of fern-like seed-plants which ages after gave us the cycads, modern conifers, and flowering plants. But preceding this period which we know as the carboniferous, or age of coal, is a stretch of time and a deposit of rock, of which as yet little is known, but of which that little makes us believe it to be probably the most interesting and most momentous in all plant history. For along its low coasts,

*One should not think of these divisions of geological time as more sharply separated than historical periods.

with broad marshes, over which the sea tides came and went for long distances, arose perhaps the first land plants. Here, through the centuries, they learned to crawl out of the sea and by degrees adapt themselves to a life on *terra firma*. Here perhaps began the ferns, horsetails, club-mosses, seed-bearing, cycad-like ferns, and the earliest relatives of the conifers. Speculation runs rife in this mysterious region, this nebula of the land-plant world. Some authorities believe our great land-plant flora developed from types similar to our fresh-water scums and slimes through the liverwort; others equally authoritative suggest they arose as sparsely small-leaved tide-water plants from the numerous plant forms of the ancient seas. Be that as it may, one fact stands out clearly, *viz.*, the presence of the two (or three?) great woody plant groups at the beginning of the coal period, and the absence of annual rings in their stems, denotes a land of perpetual summer, unmarred by seasonal changes. These two or three great groups are separated by very distinctive characters, such as the size of their leaves, the position of their fruiting bodies, and the nature of their internal anatomy.

As one traces these groups through the luxuriant but damp and gloomy forests of the coal period, one finds many strange trees. Giant club-mosses (Lepidodendrids, Sigillarians) with trunks 50 to 100 feet high, clothed with long, spiny leaves or diamond-shaped leaf scars, compete with both low-growing and tree-like types of ferns, each exceedingly abundant. Tree-like horsetails (*Calamites*) filled the swamps and their somewhat distant relatives, the *Sphenophyllales*, with curious foliage and slender, twining stems, were common. The cycad-like ferns, with "near-seeds," disputed the low grounds with the calamites, while the ancestors of the conifers (*Cordaitales*) with long slender trunks surmounted by densely branched crowns with large leaves, occupied the higher ground. These magnificent though strange and gloomy forests of the coal age were not confined to America, but characterized the flora of the whole world, east, west, north and south, indicating a climate much the same from Arctic to Antarctic. These queer forests from man's standpoint were very uninviting, as they lacked those elements which to-day make them cheery—birds, flowers, and butterflies—although some rather objectionable inhabitants were present, such as cockroaches, frogs, scorpions, and centipedes. Huge "snake-feeders," or dragon flies, with wings over two feet in spread, flitted hither and thither over the calamite marshes, while pop-eyed, queer-shaped members of the frog and salamander group made these already dark and gloomy swamps more hideous and uncanny with their croakings.

The majority of our coal fields are the carbonized remains of these immense forest and swamp areas, conditions at that time being especially favorable for their preservation as coal. All the soft and cannel coals when properly treated, cut into thin sections and subjected to microscopic examination, show wood structure, or, in the case of cannel coal, myriads of crushed pollen grains and spores with other swamp debris.

At the close of the more or less tranquil coal period, the earth again became restless. Vast changes occurred. Mountain ranges arose (among them our own eastern mountains). Enormous areas in the southern hemisphere, and to a lesser extent in the northern, were overrun by seas of ice. Europe and western North America, in part, dried up into deserts.

Plant life, very naturally, was much affected by these various changes. The giant club-moss forests were doomed, and disappeared, only remnants existing in out-of-the-way places until the end of the Paleozoic era. The swamp-loving calamites were

more fortunate, their extinction not taking place until the coming of the next era, where they gave place to the true horsetails, a much more lowly type, but perhaps better fitted to cope with the changing conditions of the long stretch of time between then and now. Ferns were more abundant than ever, running riot in variety of form and adaptability. The same was true of their near relatives, the curious cycad-like ferns which bore seed-like structures. Moreover, representatives of true cycads (sago palms) appeared. The forests of *Cordaites* gave place to still higher types of conifers, some of which had foliage similar to our present-day yews. Others were probably ancestors of the temple conifer, (*Ginkgo*) the curious maiden-hair tree, which escaped extinction from our present flora, only because it found favor in the eyes of an oriental priesthood.

The closing of the Paleozoic era marked the doom of the club-mosses, selaginellas, horsetails and their relatives as a dominating element of the earth's flora. In the coal period they had reached their millenium, both in grandeur and variety of form and in number of individuals. Henceforth to the present time, their history has been one of increasing insignificance. To-day they are represented by a few very modest, inconspicuous types such as the ground pines of our northern forests, the selaginellas or little club-mosses so common as ground carpets in tropical forests at certain elevations, and the scouring rushes (horsetails), inhabitants especially of low swampy regions and of railroad embankments. This latter group in some forms still reaches a fair height, 15–20 feet, and in a few regions they are still locally a large element of the vegetation,—relics of the past, much as are the redwoods of the Pacific coast, a group of plants once common over the whole world from Greenland to Australia.

Contrasted with the tranquil Paleozoic, the next era, the Mesozoic, is an age of marvellous activity and change, with a climate for the most part mild and seasonless. Climatic zones slowly put in their appearance as the age progressed toward its close. These zonal differences in temperature were probably slight at first, and more noticeable on the sea, the Arctic waters being cooler. Mountain-making took place on a grand scale and volcano activity, especially near the close of the era, must have presented scenes rivalling those once claimed for Gehenna, the old-time Hades. The result of all this turmoil and change lies before us to-day as the Cascades, Sierra Nevadas and the Rockies.

Animal life also seemed to be outdoing itself, especially in an effort toward grotesqueness in form and gigantic proportions. Reptiles of innumerable shapes and sizes walked and crawled over the land, swam the seas and filled the air with their whirring wings, some of which had a spread of twenty feet. Seas and rivers swarmed with crocodiles and huge turtles. Winged dragons with bird-like heads and teeth-filled jaws were no superstition in those days, nor were the mountains of flesh and bone, 50–70 feet long, which took the form of plant-and animal-eating dinosaurs, —animals, with the exception of whales, the largest the world has ever known. Birds were uncommon almost to the end of the era, while mammals (animals which suckle their young, such as are most of our present-day land animals) were small, few and insignificant.

The plants of such a world were no less marvellous, especially toward the latter half of the era, when representatives of our modern flowering plants appeared. In the first part of the era, ferns became less abundant and resembled many of our tropical forms of to-day. The club-mosses were much simpler and largely stragglers, while true horsetails, in canebrake-like thickets, occupied the margins of the swamps and inland lakes and seas, in place

**Fig. 1.** Photomicrograph of a thin section of cannel coal, showing remains of crushed spores. (After E. C. Jeffrey.)

**Fig. 2.** Highly magnified photomicrograph of a thin section of Illinois coal of the carboniferous age. Note the remains of wood structure. (After E. C. Jeffrey.)

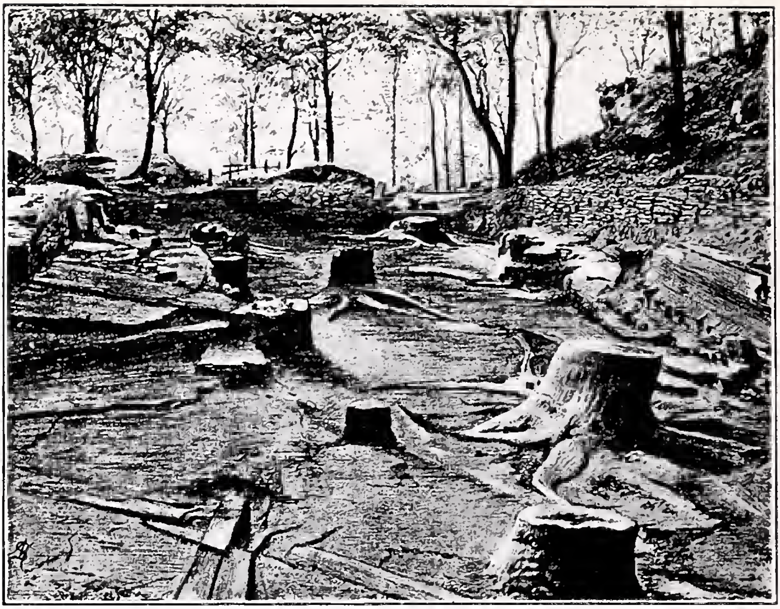

**Fig. 3.** Fossil tree stumps in a carboniferous forest, Victoria Park, Glasgow, Scotland. Probably remains of giant club mosses. (After Seward.)

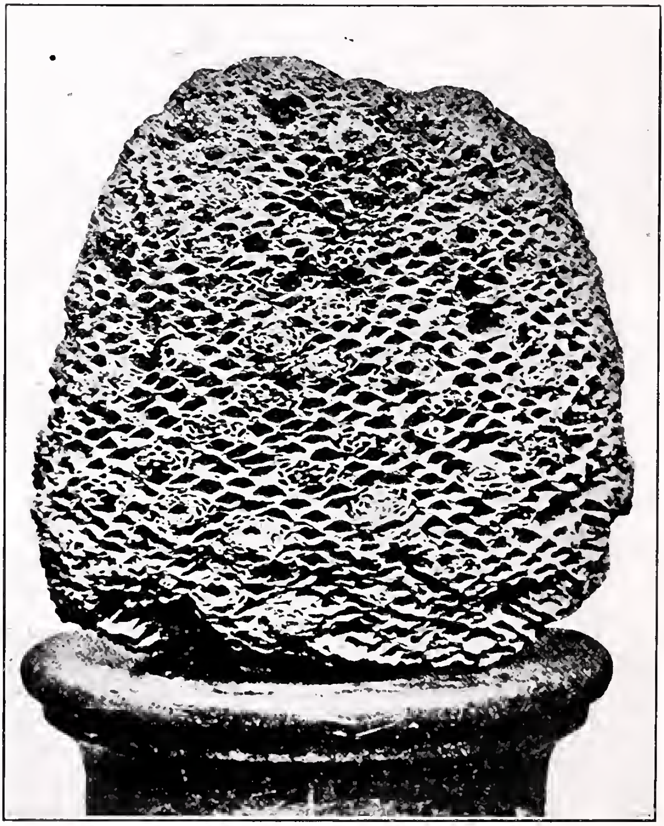

**Fig. 4.** A fossil cycad trunk from Maryland. (After Wieland.)

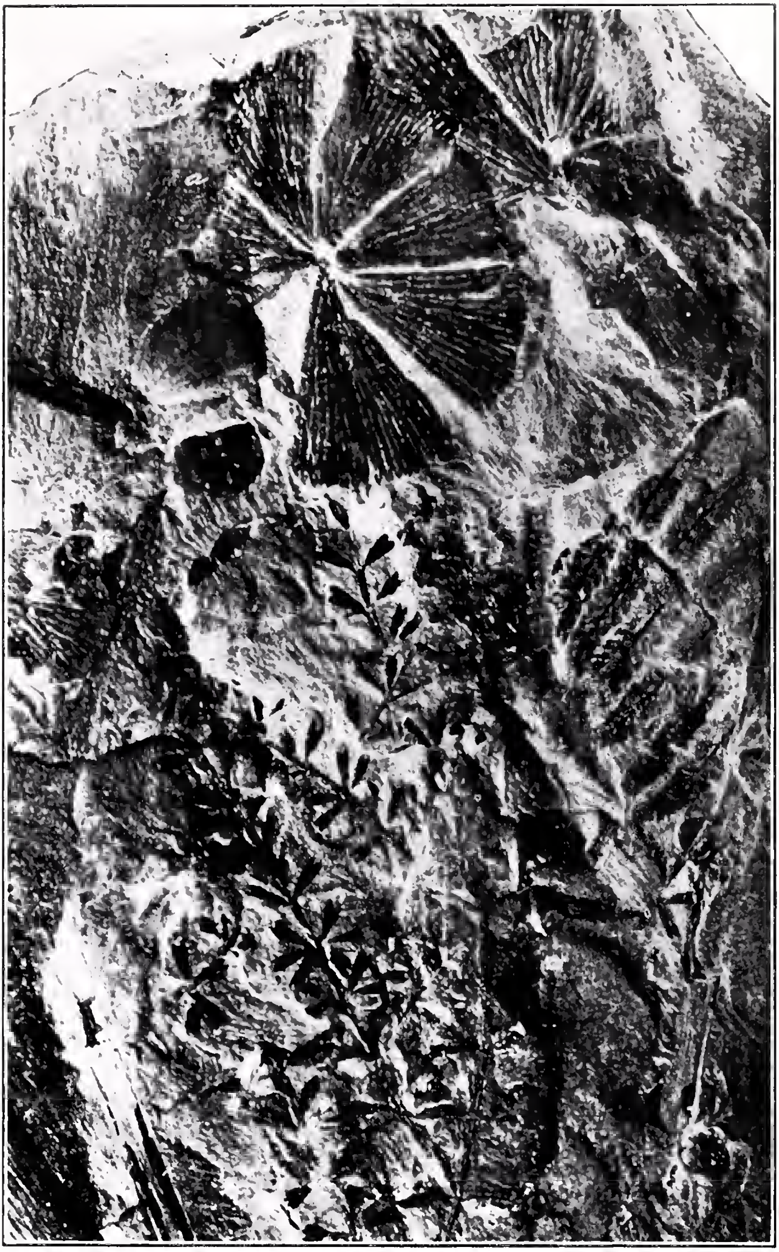

**Fig. 5.** *Spenophyllales* from the coal measures of Missouri. Two species, magnified about 2 times, are shown. (After U. S. Geological Survey.)

**Fig. 6.** A probable carboniferous landscape: 1. a tree fern; 2. *Calamites*; 3, 4. *Lepidodendron* and *Sigillaria*, giant club-mosses; 5. *Cordiates*, a primitive conifer. (After Potonié.)

of the calamites of the age just passed. Cycads were so common in the lowlands near the swamps as to give the era its name "Age of Cycads". To-day their fossil remains are widely distributed over the earth—in Greenland, the United States, Mexico, northern Asia and other regions, now far too cold for them, for their living representatives are mainly found in either the tropics or sub-tropics. The hills were covered with dense forests of conifers, the relatives of our present-day pines, cypresses and araucarias (Norfolk Island pines). These early Mesozoic landscapes, though luxuriant, were still gloomy, without the cheery song of bird or the bright colors of flowers. The fern forests of New Zealand are said to give the best modern picture of the plant life of this period. The beautiful agatized forest of Arizona (Chalcedony Park), sixty square miles or so in area, is one vast cemetery of their remains. Where once, ages ago, probably existed a beautiful and flourishing vegetation, now is nought but desolate desert, where even the adaptive flowering plant has a hard time to preserve its existence.

As the Mesozoic era progressed toward its noon, cycads became even more diversified in form and more abundant. To-day, the paleobotanist Scott estimates the ratio of cycads to other vascular plants as about one per thousand, while in the Mesozoic era, the ratio was about one in three. Their distribution was world wide, cycad fossils being especially common in New Jersey, England, Maryland, northern Mexico and the Black Hills area of South Dakota and Wyoming. In England, the miners called them "crows'-nests", while in the West our ranchmen refer to them as "petrified cactus". The latter region is probably the richest cycad cemetery in the world, over one thousand trunks belonging to twenty-nine or more species having been unearthed or picked up there. Most of these belong to a peculiar group known as Bennettitales, forms with "flowers" somewhat resembling magnolia blossoms. This remarkable similarity has led several investigators to think they might be the primitive ancestors of our flowering plants. Other investigators, however, equally prominent and authoritative, believe plants related to our pines and spruces to have been the more likely progenitors.

In the main, the middle Mesozoic flora was a continuation from that of the earlier part of the era, the chief difference being in the greater abundance of characteristic Mesozoic plants, such as ginkgos, cycads and forms of horsetails, conifers and ferns. Northern Europe was covered with tree ferns, such as now grow in much warmer regions. In the extreme north (Spitzbergen), tree trunks have been found showing annual rings, indicating the beginning of seasons—the coming of winter and summer. Over the rest of the earth, however, the evidence points toward the existence still of a warm, moist, sub-tropical climate.

And thus we come to the latter half of the Mesozoic, that part of the era in which occurred an event of more profound importance to the world, as seen through man's eyes, than either the publication of "Darwin's Origin of Species", the French Revolution, or the discovery of America For, in this part of the era, we first find flowering plants imbedded in the rocks. From whence they came and what were their ancestors is still largely mystery. Curiously their most ancient remains have been found only in a few areas in the northern hemisphere, and from this one may infer that here they originated, later migrating as successful settlers to every nook and corner of the world, excepting the oceans. These early flowering plants appear to have been largely trees and shrubs, among which were sassafras, poplar, fig trees, tulip trees and others. Of course, herbaceous forms may have existed

on the higher lands, but being comparatively fragile, were not preserved.

Later, when the newcomers had secured their bearings, many new types appeared, such as oaks, maples, walnuts, ivies, hollies, elms, beeches, chestnuts, and several kinds of monocotyledons (plants with one seed-leaf), such as sedges, palms and grasses. Before the end of the era, flowering plants were covering the land at a prodigious rate, new forms arising by the hundred, compelling the cycads, ferns and even the conifers to fall into the background. Monocotyledons are said to have been found with the most ancient remains of flowering plants. The oldest fossil of one of their principal families (the palms) was discovered in France, and resembles, in both fruit and leaf, our modern cocoanut palms. Greenland at this time, instead of being a cold, icebound, forestless wilderness with a meager alpine vegetation, had at least a temperate climate, with a flora of elms, oaks, maples and magnolias.

The Cenozoic era, from a plant standpoint, started right, but failed to keep its early promise. At its outset, the climate was mild and equable, with a luxuriant vegetation flourishing far within the Arctic circle. By slow degrees, with many see-sawings, the atmosphere grew colder, the latter half of the era being marked by a reign of ice. Though glaciers only covered part of the northern and southern hemispheres, it is probable that the temperature of the whole earth was considerably lowered. Mountain-making during the first part resulted in the Alps, Caucasus, Himalayas and in further elevating the Rockies. Almost all the continents were united by land connections at different times, as well as disunited. It was an age of travelling, probably on the grandest scale the world has ever known. Land animals and plants, because of climatic and geographical changes, were apparently continually on the move—here, there and everywhere. The whole living world turned gypsy. The elephant family came to America, and camels and horses, originally native to our continent, crossed over to Asia. The reptilian monsters died, and as with the Paleozoic club-mosses, left only their comparatively small and insignificant relatives, snakes, crocodiles, etc., to keep alive their traditions. In their place came the mammals, including man. Fish, bird, beast and plant, in general, differed but little from those of to-day, though their distribution over the globe have undergone remarkable changes.

In the forepart of the era subtropical temperatures prevailed in Europe and the United States. Mingled with the ferns, horsetails, pines, sequoias (redwoods), and yews, relics of the more ancient vegetation, were the willows, elms, palms, bananas, myrtles, beeches, magnolias, and walnuts, of the modern period. Fossil ginkgo leaves have been collected by the hundred in western Montana, where now are forests of spruce and cottonwood. Palms grew in northern Germany, and Alaska had a temperate climate flora. Cycads were rare and had practically assumed their present position. Lemurs and primitive monkeys swarmed in the North American forests. Poisonous snakes were still unknown. Little horses no bigger than a cat, with toes instead of hoofs, roamed the grassy, park-like glades, while the dusky, forest aisles and subtropic nights first heard the swish and squeak of flying bats.

As the era sped forward and the climate slowly cooled, the monkeys willed their forest homes to the squirrels and disappeared from the region. Plant life greatly changed.

Grasses multiplied and prairies arose. Magnolias, beeches, and sycamores still lived as far north as southern Montana, while

the bread-fruit (similar to our tropical form) grew in Oregon. Palms flourished in Colorado. Conifers were extremely abundant and of many kinds. Sequoias (redwood, "big trees" of California) of many varieties during this era were distributed all over the world, both south and north, instead of being confined to their present small Pacific coast area. Europe, perhaps, in its flora, was more like the India of to-day—a mixture of temperate and subtropical plants. Little is known of the North American flora just preceding the glacial period, but in Europe tropical and subtropical forms gradually disappeared, while temperate forms, such as tulip trees, poplars, and oaks, took their place. Plant life just before the reign of ice approximated very closely that of to-day, though it was differently distributed. Tulip trees, sequoias, and magnolias, once plentiful, have long been absent from European floras, while the ranges of many of our North American plants have been much altered.

While the earlier part of this era was marked by great volcanic activity all over the northern hemisphere, the latter part is remarkable for its reign of ice. Several great ice sheets swept over parts of the northern and southern hemispheres, and reindeer lived as far south as France and Arkansas. Arctic plants came south during the glacial period and retreated north again during the periods of mild climate, or up the mountain peaks, which answered the same purpose; *e. g.*, the Alps and the White Mountains. Climatic changes resulted in the extinction of much of the northern flora; hence, to-day the southern hemisphere, where climatic changes perhaps were not so destructive, is a vast museum of relics of a flora that was once world wide, while in the northern hemisphere, in general, the plants are much more modern. Somewhere during this era, possibly in Malaysia or southern Asia, man appeared, and, at the time of the ice age, he had discovered Europe.

Since his coming, changes in geography, climatic and plant distribution have been and still are in progress, as any serious student of these subjects will tell you. New forms of plants are still arising, as any plant-breeder or modern-trained student of plant evolution will affirm. These are no longer subjects for argument; from the realm of theory they have been transferred to that of fact. To-day the oldest living things are the giant sequoias or redwoods of California, some of which are over 3,000 years old. To-day the plant world is largely dominated by the flowering plants, both in number of species and individuals. From this standpoint the following list of plant species belonging to each of the large groups may be interesting, though the number of species sheds but little light upon the actual numerical predominance of individuals of a species in a given flora. These figures are approximations:

| | |
|---|---|
| Flowering plants | 125,000 |
| Conifers | 450 |
| Ferns | 3,500 |
| *Club-mosses and allies | 500 |
| Mosses and liverworts | 12,000 |
| Fungi and bacteria | 64,000 |
| Lichens | 5,500 |
| Algae (seaweeds, pond slimes, etc.) | 14,000 |
| | 224,950 |

*From the standpoint of the fossil record and those who study it, there is no justification, save that of custom, for considering the club-mosses as fern allies. If these students have correctly interpreted the rock-written records, the ancestors of our present-day ferns and lycopods are much further apart than ferns and flowering plants, at least as regards the time element.

After reading this LEAFLET, if one is interested enough to read a more extended popular account, either D. H. Scott's "The Evolution of Plants" or Seward's "Links with the Past in the Plant World" will be found very entertaining. "Hypothetical ancestral trees" have a tendency to promote dogmatism in the casual reader, but, if one is interested, several of the latest, embodying the views of America's most eminent authorities, may be found in chapters 36-38, C. S. Gager's "Fundamentals of Botany." "Outlines of Geological History," by Willis and Salisbury, and "The Evolution of the Earth and Its Inhabitants," edited by R. S. Lull, will interest those more profoundly inclined. There are other ways, of course, than those of studying the fossil record by which one may investigate the evolution of plants, but the latter probably gives the most accurate data.

ORLAND E. WHITE.

## NOTICES

The Garden is open free to the public daily, from 8 a. m. until dark; on Sundays and holidays at 10 a m. The Laboratory Building, containing the library, herbarium, and offices, is open daily (except Sundays), from 9 a.m. until 5 p. m. (Saturdays, 9–12). The Conservatories are open April 1–October 1, 10 a. m.–4:30 p. m. (Sundays, 2-4:30); October 1–April 1, 10 a. m.–4 p. m. (Sundays, 2-4).

The Garden may be reached by Flatbush Ave. trolley to Empire Boulevard; Franklin Ave., Lorimer St., and Tompkins Ave. trolleys to Washington Ave.; St. John's Place and Rogers Ave. trolleys to Sterling Place; Vanderbilt Ave., Sixteenth Ave., Union St., Greenpoint, and Smith St. trolleys to Prospect Park Plaza and Union St., and Brighton Beach elevated to Botanic Garden Station.

A docent will meet parties by appointment and conduct them through the Garden. This service is free to members of the Botanic Garden and to teachers with classes; to others there is a nominal charge of 25 cents an hour for parties of less than three, and 10 cents a person per hour for parties of three or more.

Subscription for LEAFLETS **fifty cents a series** (comprising about fourteen numbers); free to members of the Botanic Garden and to teachers.

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BROOKLYN BOTANIC GARDEN

# LEAFLETS

SERIES VIII BROOKLYN, N. Y., MAY 5, 1920. NOS. 6–8.

## THE BROOKLYN BOTANIC GARDEN COLLECTION OF PORTRAITS OF BOTANISTS

The following statements about distinguished botanists were prepared as legends under portraits, collected for the Garden, and hung in the corridors of the laboratory building on May 11, 1920. The information is from miscellaneous sources, including especially Sach's *History of Botany*, Agnes Arber's *Herbals* and Miall's *Early Naturalists*. The portraits will be added to from time to time.

### THE GREEKS

#### Aristotle

(*b*. Stagyra, Thracia, 384 B. C. *d*. Chalcis, Euboea, 322 B. C.) Father of natural science. Pupil of Plato, teacher of Alexander the Great and of Theophrastus. Lectured near Athens for twelve years. His writings on plants have been lost. Is said to have established the first botanic garden of which there is record.

#### Theophrastus

(*b*. Eresos, Island of Lesbos (now Mitylene), 370 B. C. *d*. Athens, 285 B. C.)
"First of real botanists in point of time." Pupil and successor of Aristotle. His books *On the History of Plants* and *On the Causes of Plants*, the earliest botanical works now in existence, take up about five hundred species. No more extensive botanical studies were made for 1800 years. He divided plants into trees, shrubs, half-shrubs, and herbs. "The whole population of Athens, honoring him greatly, followed him to the grave."

### SIXTEENTH CENTURY

#### Otto Brunfels

(*b*. Mainz, Germany, 1464 (?). *d*. Berne, Switzerland, 1534.)
First of the "German fathers of botany". His *Herbarum vivae eicones* (1530) marks the beginning of modern botany by publishing the first illustrations made directly from plants.

#### Leonhard Fuchs

(*b*. Wembingden, Bavaria, January 17, 1501. *d*. Tübingen, Würtemberg, 1566.)
Professor of medicine at the University of Tübingen (1535-1566).

His *De historia stirpium commentarii insignes* (Basel, 1542) contains 500 excellent outline illustrations of plants of the Rhine region. *New Kreuterbuch* (1543). The genus *Fuchsia* was named in his honor.

**Andrea Cesalpini**

(*b.* Arezzo, Italy, June 6, 1519. *d.* Rome, February 23, 1603).

Pupil of Ghini. Professor at the University of Pisa, Physician to Pope Clement VIII. He emphasized the importance of the fruit in classification, and his work *De plantis libris XVI* (1583), marks the beginning of modern systematic botany. First to point out the anatomical distinction between root and stem. Called by Linnaeus "the first of systematists." His writings gave direction to morphological and systematic botany throughout the seventeenth and part of the eighteenth centuries.

**Lobelius (Mathias de l'Obel)**

(*b.* Lille, France, 1538. *d.* Highgate, England, March 2, 1616).

Physician to William the Silent, and, later, Botanist to James I, of England. In his *Stirpium adversaria nova* (1570) he separated plants having netted veined from those having parallel veined leaves, thus roughly separating the Monocotyledons from the Dicotyledons. The genus *Lobelia* was named in his honor by Plumier.

## SEVENTEENTH CENTURY

**Gaspard Bauhin**

(*b.* Basel, Switzerland, January 17, 1560.
*d.* Basel, December 5, 1624).

Professor in Basel. Botanized in France, Switzerland and Italy. Author of the famous *Pinax theatri botanici* (1623), describing 6,000 species of plants and clearly distinguishing between species and genera. He gave concise diagnostic descriptions of species and was one of the first to recognize natural affinity as the basis of a system of classification. "The Linnaeus of the Sixteenth Century."

**John Tradescant Senior**

(*b.* Holland. *d.* Lambeth, England, August, 1638).

Traveller and collector of natural history objects. Gardener to King Charles I. The genus *Tradescantia* was named in his honor.

**John Tradescant Junior**

(*b.* Meopham, Kent, England, 1608.
*d.* Lambeth, April 22, 1662).

Succeeded his father as royal gardener. He visited Virginia, enriching his father's collections, which finally went, "twelve cartloads of curiosities", to the Ashmolean Museum, Oxford. Author of *Museum Tradescantianum: or, a Collection of rarelies. Preserved at South Lambeth neer London by John Tradescant.* (1656).

**Marcello Malpighi**

(*b.* Crevalcuore, near Bologna, Italy, May 10, 1628.
*d.* Rome, November 29, 1694).

Professor in Bologna (1656), Pisa, Messina, and again in Bologna. Physician to Pope Innocent XII (1691). Co-founder, with Grew, of the science of plant anatomy (1694). First to observe and figure stomata. *Anatomes plantarum idea* (1671). His *Anatome*

*plantarum* (1675), with numerous illustrations, contained the first account of sieve tubes. "In performing these researches so many marvels of nature were spread before my eyes that I experienced an internal pleasure that my pen could not describe."

**Nehemiah Grew**

(*b.* Coventry, Warwickshire, England, 1641.
*d.* London, March 25, 1712).

With Malpighi, co-founder of plant anatomy. *Anatomie of vegetables begun* (1671). Secretary of the Royal Society (1677-1682). His *Anatomie of plants* was authoritative for 130 years. He pointed out the difference between seeds with one and two cotyledons. Introduced the term "parenchyma", and, with Millington, first suggested the idea that stamens are male organs.

**Robert Morrison**

(*b.* Aberdeen, Scotland, 1620. *d.* London, November 9, 1683).

First professor of botany in Oxford (1669), and *Horti Praefectus* of the Physic Garden. Physician to Charles II. His *Monograph of the Umbeltiferae* (1672) was the first monograph of a single large family. His *magnum opus*, *Historia plantarum universalis Oxoniensis* (1699) was completed after his death. He was the first to form a genealogical tree.

**John Ray**

(*b.* Black Notley, Essex, England, November 29, 1627.
*d.* Black Notley, January 17, 1705).

He introduced the terms monocotyledon and dicotyledon, making the number of cotyledons the basis of his subdivision of "flowering herbs". His great *Historia plantarum* (1686-1704) described 18,000 species, and summarized all that was then known concerning the nutrition of plants. He was one of the few early botanists to recognize the existence of sex in plants.

**Joseph Pitton de Tournefort**

(*b.* Aix, France, June, 1656. *d.* Paris, December 28, 1708).

Professor in the *Jardin du Roi*, under Louis XIV (1683-1708). Botanist in Asia, Africa, and Greece. In his *Institutiones rei herbariae* (1700), the standard of authority until Linnaeus, he was the first to assign characters to genera. Emphasized the importance of the characters of the flower. He declined to accept the doctrine of the sexuality of plants, and taught that the movements of plants are produced by muscles.

**Rudolph Jacob Camerarius**

(*b.* Tübingen, Würtemberg, February 17, 1665.
*d.* Tübingen, September 11, 1721).

Professor extraordinary and Director of the botanic garden in Tübingen (1688); professor of natural philosophy (1689); first professor of the University (1695). By three years of careful experiment he was the first to demonstrate the sexuality of plants, and the necessity of pollination for the formation of seeds. His results were communicated in a letter, *De sexa plantarum epistola* (1694), the most elaborate treatment of the subject prior to the middle of the eighteenth century.

**Stephen Hales**

(*b.* Bekesbourne, Kent, England, September 7, 1677.
*d.* Teddington, near London, January 4, 1761).

Brilliant experimentalist, and one of the founders of plant physiology. *Vegetable staticks* (1727). First to make experiments in transpiration, plant growth and root-pressure; one of the first to prove that the solid substance of plants is largely derived from the air. Fellow of the Royal Society; honored by an inscription in Westminster Abbey.

**Linnaeus (Carl von Linné)**

(*b.* Rashult, Sweden, May 23, 1707.
*d.* Upsala, January 10, 1778).

Father of modern systematic botany. Professor in Upsala for thirty-seven years. Defended the fixity of species, asserting that "There are as many species as were created in the beginning". In his *Systema naturae* (1735) he adopted a simple artificial system of classification. *Philosophia botanica* (1751). His *Species plantarum* (1753) is the starting point of binomial nomenclature.

**Johann Hedwig**

(*b.* Kronstadt, Transylvania, October 8, 1730.
*d.* Leipzig, February 18, 1799).

Physician. Professor of botany in Leipzig (1789-1799). His *Fundamentum historiae naturalis muscorum frondosorum* (1782-1783) marks the beginning of the systematic study of the mosses. He mistakenly considered the antheridia as anthers, the capsule as a fruit, the spores as seeds, and the protonema as a cotyledon.

**Michel Adanson**

(*b.* Aix, Provence, France, April 7, 1727.
*d.* Paris, August 3, 1806).

Historian of botany. Opposed the system of Linnaeus, and urged the desirability of classifying plants in natural families. *Histoire de Botanique* (1764); *Familles des plantes* (1763). First described the movement of *Oscillatoria* (1767).

**Antoine Laurent de Jussieu**

(*b.* Lyons, France, September 19, 1748.
*d.* Paris, September 17, 1836).

First Director of the Jardin des plantes (1793). Studied with his uncle, Bernard de Jussieu. In his *Genera plantarum secundum ordines naturalis disposita* (1789) he adopted three main groups—Acotyledones, Monocotyledones, Dicotyledones—and under these groups, for the first time, described plant families (long called orders), one hundred in number; under families he described the genera. Linnaeus declared himself unequal to the task. Jussieu was called, by Richard, "the first botanist in Europe".

**Jan Ingen-Housz**

(*b.* Breda, Holland, December 8, 1730.
*d.* Bowood, near London, September, 1799).

Physician to the Emperor of Austria; later, a resident in England. Early plant physiologist. He was the first clearly to demonstrate that both sunlight and leaf-green are necessary for the fixation

of carbon in plants from the carbon dioxide of the air (photosynthesis). First to distinguish between photosynthesis and respiration (1779). His *Experiments on Vegetables* (1779) was translated into three languages.

### Joseph Gottlieb Kölreuter

(*b.* Würtemberg, Germany, April 17, 1733.
*d.* Karlsruhe, Baden, November 12, 1806).

Professor (1762), and director of the Botanic Garden, Karlsruhe (1763-1786). First to investigate the sexuality of plants scientifically. He was one of the first to explain the purpose of nectar and the function of insects in pollination. He produced the first plant hybrids. His important work *Preliminary account of a few experiments and observations concerning the sex of plants*, was published between 1761 and 1766.

## EARLY NINETEENTH CENTURY

### Augustin Pyrame de Candolle

(*b.* Geneva, February 4, 1778. *d.* Geneva, September 9, 1841).

Famous systematist. Professor in Geneva. *Theorie elementaire de la botanique* (1813, 1819). His *Prodromus systematis naturalis regni vegetabilis*, begun in 1824, and continued for fifty years, was called by Sachs "the grandest work of descriptive botany yet in existence". First to classify plants into vascular and non-vascular (cellular). The amount and compass of his labors are said to exceed those of any botanist before or after him.

### Robert Brown

(*b.* Montrose, Scotland, December 21, 1773.
*d.* London, June 10, 1858).

Librarian to Linnaean Society (London). Custodian of the British Museum (1823-1858). Discovered and made the first detailed study of the nucleus. Called by Humboldt "*Botanicorum facile princeps*". Discovered the gymnospermy of cycads and conifers (1827). Collected nearly 4000 new species of plants in Australia (1801-1805). First to distinguish clearly the embryo-sac, the integments and nucellus of the ovule, and to interpret correctly the hilum, the micropyle, and the endosperm.

### Thomas Andrew Knight

(*b.* Wormsesly Grange, Ludlow, Herefordshire, England, August 12, 1759. *d.* London, May 11, 1838).

Horticulturist, physiologist, and first English plant-breeder. Fellow of the Royal Society (1805), Copley medalist (1806). One of the founders and president of the Horticultural Society (1811-1838). Did important work in the improvement of cultivated plants. First to demonstrate experimentally that the direction of growth of roots and stems is due to the influence of gravity.

### Johann Heinrich Friederich Link

(*b.* Hildersheim, Germany, February 2, 1767.
*d.* Berlin, January 1, 1851).

Professor of Botany and director of the Botanic Garden in Berlin (1815-1851). Author of the Göttingen prize essay (1804), *Grundlehren der Anatomie und Physiologie der Pflanzen*, in which he demonstrated that all algae, fungi and lichens are plants, and

that the filaments of lichens and fungi consist of cells. Noted also as a teacher and author of popular works.

**Charles Francois Brisseau de Mirbel**

(*b.* Paris, March 22, 1776.
*d.* Champerret, near Paris, September 12, 1854).

Founder of microscopic plant anatomy in France. *Traite d'anatomie et de physiologie vègètale* (1802). Membre de l'Institut (1803). Professor of botany in the University of Paris. Attacked for teaching plant anatomy and physiology at the sacrifice of systematic bótany in the Sorbonne. He was the first to recognize that all plant tissue is modified parenchyma. Made the first thorough study of the liverwort, *Marchantia* (1835).

**Friedrich Wilhelm Heinrich Alexander von Humboldt**

(*b.* Berlin, September 14, 1769. *d.* Berlin, May 6, 1859).

Naturalist and traveller. Author of *Kosmos*. He explored South America, and in his *Essai sur la geographie de plantes* (1805), in collaboration with Aimé Bonpland, he laid the foundations of the science of plant geography. First to use isothermal lines. Agassiz said of him: "The influence he has exerted upon the progress of science is incalculable. . . . With him ends a great period in the history of science".

**Stephen Elliott**

(*b.* Beaufort, South Carolina, November 11, 1771.
*d.* Charleston, March 23, 1830).

Representative and senator in the state legislature. President of the State Bank. Editor of the "Southern Review". For some years professor of botany in the South Carolina Medical College. *Sketch of the botany of South Carolina and Georgia* (1821-1824). This was the first detailed work on the systematic botany of the southern United States.

**Thomas Nuttall**

(*b.* Settle, Yorkshire, England, January 5, 1786.
*d.* St. Helen's, Lancashire, September 10, 1859).

Botanist and ornithologist. He resided for thirty-three years in America. For nine years curator of the Botanic Garden of Harvard College. *Genera of North American plants and catalog of the species of the year 1817.* He travelled in almost every state of the Union and is credited with more new species than any other explorer in North America.

**Rafinesque (Constantine Samuel Rafinesque-Schmaltz)**

(*b.* Galatz, near Constantinople, October 22, 1783.
*d.* Philadelphia, September 18, 1840).

Coming to the United States at the age of nineteen, he became interested in the flora of North America. For seven years teacher in Transylvania University (Kentucky), being the first teacher of natural science west of the Appalachian Mountains. He founded numerous genera and species of plants, (also twelve "new species" of thunder and lightning). *New flora and botany of North America* (1836). Early defender of evolution.

**Elias Magnus Fries**

(*b.* Femsjö, Småland, Sweden, August 15, 1794.
*d.* Upsala, February 8, 1878).
Professor of botany in Lund (1824-1834), and in Upsala (1851-1878). Shares with Persoon the honor of being the founder of systematic mycology. *Systema mycologicum* (1821-1829).

**Giovanni Battista Amici**

(*b.* Modena, Italy, March 25, 1786. *d.* Florence, April 10, 1863). Director of the Astronomical Observatory in Florence. He greatly improved the microscope, and was the first to see the pollen tube enter the micropyle. Also first to observe the germination of pollen-grains (1823), and first to demonstrate that the embryo is formed in the embryo-sac (1846).

**Adolf Theodore Brongniart**

(*b.* Paris, January 14, 1801. *d.* Paris, February 18, 1876). Founder of the science of paleobotany. Professor in the Museum d'Histoire Naturelle (1833-1876). His great *Histoire des vegetaux fossiles*, appearing for nine years, was never completed. *Tableaux de genres de vegetaux fossiles* (1849). He established the general fact of the germination of pollen-grains on the stigma, and introduced the term "embryo-sec". The botanic gardens of Paris and other French cities are still laid out according to his classification.

**Oswald Heer**

(*b.* Nieder-Utzwyl, St. Gallen, Switzerland, August 31, 1809.
*d.* Lausanne, September 27, 1883).
Entomologist and paleobotanist. Professor of botany in Zürich (1851) and director of the botanic garden there. His *Flora tertiaria helvetiae* (1855-1859) and *Flora fossilis arctica* (1868-1883) are classical works on fossil plants. Of the former it has been said that "Nothing comparable to it had appeared before, and nothing equal to it has appeared since."

**Leo Lesquereux**

(*b.* Fleurier, Neufchatel, Switzerland, November 18, 1806.
*d.* Columbus, Ohio, October 25, 1889).
Came to America with Agassiz and Guyot in 1848, when the Geneva Revolutionary Council suppressed the Academy at Neufchatel. Student of mosses and American fossil plants, especially of the coal formations. Prepared, with Sullivant, the *Musci Americana exsiccati*. His work on Pennsylvania plant fossils was the most important work on carboniferous plants produced in America.

**Matthias Jakob Schleiden**

(*b.* Hamburg, Germany, April 5, 1804.
*d.* Frankfurt-am-Main, June 23, 1881).
Professor at Jena (1850). Co-founder, with Schwann, of the cell theory. Emphasized the study of development as a foundation of morphology. By the vigor of his thought he gave a great impulse to botanical research. With Nägeli, he established the *Zeitschrift für wissenschaftliche Botanik* (1844). The appearance

of his *Grundzüge der wissenschaftliche Botanik; Die Botanik als inductive Wissenschaft* (1842-1843) at once raised botany to the rank of a modern natural science.

**Hugo von Mohl**

(*b.* Stuttgart, Würtemberg, April 8, 1805.
*d.* Tübingen, Würtemberg, April 1, 1872).

One of the founders of plant anatomy. Professor of botany in Tübingen (1835-1872). He introduced the name "*protoplasm*", and was the first to describe vegetative cell-division (1835). Founder (with Schlechtendal) of the *Botanische Zeitung* (1843). *Mikrographie* (1846). Skillful microscopist, for forty years an investigator in plant anatomy. He was acquainted with the entire range of botanical science, and was noted for the accuracy of his observations, drawings, and descriptions.

**Nathanael Pringsheim**

(*b.* West Zieski, Silesia, November 30, 1833.
*d.* Berlin, October 6, 1894).

He demonstrated sexual reproduction in *Vaucheria*, and was the first, in 1856, in the alga, *Oedogonium*, to observe fertilization, or the fusion of a plant sperm and an egg. He first described the alternation of generations in algae. Founder (1858) of the *Jahrbücher für wissenschaftliche Botanik*.

**Wilhelm Friedrich Benedict Hofmeister**

(*b.* Leipzig, Germany, May 18, 1824.
*d.* Lindenau, near Leipzig, January 12, 1877).

Called by Bonnier "perhaps the greatest genius who has ever appeared in botanical science". Professor of botany in Heidelberg (1863) and in Tübingen (1872). While a music dealer he demonstrated the fact of the alternation of generations in lower and higher groups of plants, which implied the doctrine of evolution. He also demonstrated the origin of the plant embryo from the ovum. His epoch-making *Vergleichende Untersuchungen* was published in 1849-1851.

**Charles Robert Darwin**

(*b.* Shrewsbury, England, February 12, 1809.
*d.* Down, Kent, April 18, 1882).

Co-discoverer, with Wallace, of the principle of natural selection. His *Origin of species by means of natural selection* (1859) was one of the most influential works ever published in any language. *The variation of animals and plants under domestication* (1876). His voyage of exploration on the Beagle has been called "a Columbus voyage of science". His work gave direction to all modern thought.

**Karl Wilhelm von Nägeli**

(*b.* Kilchberg, near Zürich, Switzerland, March 27, 1817.
*d.* Munich, May 10, 1891).

Swiss botanist and philosopher. Professor in Munich (1857). Early adherent to a strictly inductive method. With Schleiden he introduced into morphological study the idea of the history of development. First to determine that all vegetative cells are formed by the existence of pre-existing cells. He discovered the sperms of ferns, and made contributions to almost every department of botany. With Schleiden he founded the *Zeitschrift für wissenschaftliche Botanik* (1844).

### Johann Gregor Mendel

(*b.* Heinzendorf, near Odrau, Silesia, July 22, 1822.
*d.* Brünn, January 6, 1884).

Priest and teacher of science at Brünn. Through plant-breeding studies on peas he discovered the most important laws of heredity, expounded in his *Versuche über Pflanzen-Hybriden* (1865). This paper remained unnoticed until 1900, thirty-four years after its publication. Mendel often said, "My time will yet come". His work has proved to be the greatest stimulus ever given to the experimental investigation of heredity.

### John Torrey

(*b.* New York City, August 15, 1796.
*d.* New York City, March 10. 1873).

Professor of chemistry at West Point; later, professor of chemistry and botany in the College of Physicians and Surgeons, New York, and professor of chemistry at Princeton. State Botanist of New York (1836). *Catalogue of plants growing within thirty miles of New York* (1819). *Flora of the Northern and Middle States* (1824). Teacher of Asa Gray. First president of the Torrey Botanical Club. Called by Gray the "Nestor of American Botany".

### William Starling Sullivant

(*b.* Franklinton, near Columbus, Ohio, January 15, 1803.
*d.* Columbus, April 30, 1873).

American bryologist. *Musci and Hepaticae of the United States east of the Mississippi river* (1856); first published in the second edition of Gray's Manual. *Icones Muscorum* (1864) was completed by Lesquereux. The rare Saxifrage, *Sullivantia*, was named in his honor.

### Asa Gray

(*b.* Sauquoit, Oneida County, New York, November 18, 1810.
*d.* Cambridge, Massachusetts, January 30, 1888).

Professor in Harvard University. Director of Harvard Botanic Garden. Foremost American systematist. *Structural botany* (1842). *Manual of botany*, First Edition (1847); Seventh Edition (1908). Defender of Darwin in America. First to call attention to and explain the similarity in the floras of North America and Eastern Asia. With Torrey, his teacher and associate, he was among the first to abandon the Linnaean classification.

### George Engelmann

(*b.* Frankfurt-am-Main, Germany, February 2, 1809.
*d.* St. Louis, Missouri, February 4, 1884).

Physician, editor, and botanist. Author of systematic works on *Cactaceae*, *Cuscuta*, and the oaks. First president of the St. Louis Academy of Science. Through Engelmann, "Shaw's Gardens" became a botanical garden, from which has developed the Missouri Botanical Garden.

### Julius Ferdinand Cohn

(*b.* Breslau, January 24, 1828. *d.* Breslau, June 25, 1898).
One of the founders of bacteriology. Made important contributions to our knowledge of fermentation and the microscopic organisms in drinking waters. Founder of *Beiträge zur Biologie der Pflanzen* (1870). *Untersuchungen über Bacterien* (1872-75).

### Louis Pasteur

(*b.* Dôle, Jura, France, December 27, 1822.
*d.* Villeneuve-l'Etang, near St. Cloud, September 8, 1895).

Founder of the science of bacteriology. Disproved by rigid experiments the doctrine of spontaneous generation (1860). Demonstrated the relation between fermentation and anaerobic respiration, and that fermentations and infectious diseases are produced by the development of special microbes. Founder of the Pasteur Institute (1888), L'Academie des Sciences (1869), L'Académie Française (1882). "*La vie c'est le germ, et le germ c'est la vie*".

### Heinrich Anton de Bary

(*b.* Frankfurt-am-Main, Germany, January 26, 1831.
*d.* Strassburg, January 19, 1888).

Founder of modern mycology, and the first to prove that the substance of *Myxomycetes* is protoplasm. First to describe the phenomenon of alternate hosts (heteroecism) in the life history of the plant Rusts. *Morphologie und Physiologie der Pilze, Flechten und Myxomyceten* (1866). *Vergleichende Anatomie der Vegetationsorgane der Gefässplanzen* (1877).

### Jean Baptiste Joseph Dieudonne Boussingault

(*b.* Paris, February 2, 1802. *d.* Paris, May 11, 1887).

Professor in Paris. Introduced modern methods of experimenting in plant nutrition. His work, *Agronomie, chemie agricole et physiologie* (1860-1874), was the foundation of soil-chemistry. He showed that plants do not obtain their nitrogen from the air, but from the soil in the form of nitrates, thus overthrowing the erroneous doctrine of the humus, which had persisted from Aristotle to Liebig.

### Ferdinand Gustav Julius von Sachs

(*b.* Breslau, Silesia, October 2, 1832. *d.* Würzburg, May 29, 1897).

Historian of botany. Founder of modern plant physiology. Professor of botany in Würzburg (1868-1897). *Handbuch der Experimental Physiologie der Pflanzen* (1865). *Lehrbuch der Botanik* (1868). *Geschichte der Botanik* (1875). The publication of his *Vorlesungen über Pflanzenphysiologie* inaugurated a new epoch in plant physiology. Under his influence schools of botanical research sprang up in many universities.

### George Bentham

(*b.* Stoke, near Plymouth, England, September 22, 1800.
*d.* London, September 10, 1884).

Foremost of systematists; keeper of the herbarium, Kew. Published a series of floras. Joint author, with Sir Joseph Hooker, of the great *Genera Plantarum* (1862-1883).

### Joseph Dalton Hooker

(*b.* Halenworth, Suffolk, England, June 30, 1817.
*d.* Sunningdale, Berkshire, December 10, 1911).

Explorer, systematist, and scientific administrator. Second Director of the Royal Botanic Garden, Kew. With Bentham, he published the monumental *Genera plantarum* (1862-1883). His work on the *Flora of British India* (1875-1897) has been characterized as "the most remarkable study of a vast and varied flora that has ever been carried through by one ruling mind". At Darwin's suggestion he directed the preparation of the indispensable *Index Kewensis*.

### Louis Charles Joseph Gaston Marquis de Saporta

(*b.* St. Vacharie, Var, France, July 28, 1823.
*d.* Aix-en-Provence, January 26, 1895).
One of the founders of the science of paleobotany. *Plantes jurassiques* (1873-1883). His determinations are supported by intensive comparisons of fossil with living plants. He was the first paleobotanist ardently to support the theory of evolution. *L'évolution du règne végétale* (1881).

### Edward Tuckerman

(*b.* Boston, Massachusetts, December 7, 1817.
*d.* Amherst, March 15, 1886).
Professor of history; later (1851-1886), professor of botany in Amherst College. First American authority on lichens. He also studied mosses. *Carex*, and *Potamogeton*, *Genera lichenum* (1872). *Synopsis of North American lichens* (1882-1888).

### Simon Schwendener

(*b.* Räfis, Canton, St. Gallen, Switzerland, February 10, 1829).
Director of botanic garden in Basel, and later in Tübingen. Professor of physics in Berlin (1878). Investigator of lichens and of plant anatomy. He was the first to demonstrate the nature of lichens (first suggested by de Bary), namely, that they are composed of a fungus growing symbiotically with a green alga.

### Eduard Adolf Strasburger

(*b.* Warsaw, Poland, February 1, 1844.
*d.* Poppelsdorf-Bonn, May 19, 1912).
Professor in Bonn (1887-1912). Investigator of plant physiology and morphology. Showed that the nuclei of the sporophyte contain twice as many chromosomes as those of the gametophyte. Made many important contributions to our knowledge of fertilization and life histories. We are mainly indebted to him for working out the details of fertilization of plant eggs by the sperms derived from the pollen.

### Harry Marshall Ward

(*b.* Hereford, England, March 21, 1854.
*d.* Torquay, England, August 26, 1906).
Distinguished plant pathologist. Professor in the Royal Engineering College (1885-1895), and in the Cambridge University (1895-1906). Fellow of the Linnaean Society of London, member of the Royal Society, and Royal Medalist. President of the British Mycological Society (1900-1902). First to show that a parasitic fungus secretes an enzyme that softens the tissues of the host plant, thus making possible the penetration of woody tissue by the delicate fungal filaments.

### Herman Müller

(*b.* Thüringen, Germany, September 23, 1829.
*d.* Lippstadt, August 25, 1883).
With his brother, Fritz Müller, the embryologist, he made extensive studies of the pollination of flowers. His important work, *Die Befruchtung der Blumen durch Insecten*, published in 1873, described the method of cross pollination in more than four hundred species of plants.

**Kerner (Anton Joseph Kerner Ritter von Marilaun)**

(*b.* Mautern, Austria, November 12, 1831.
*d.* Vienna, June 21, 1898).

Director of the botanic gardens and professor in Innsbrück (1860) and in Vienna (1878). His valuable *Pflanzenleben* (1887-1891), translated into English and edited by Oliver, as the *Natural history of plants*, was a pioneer and influential work in ecological botany; it was also translated into other languages.

**Leo Errera**

(*b.* Laeken, Belgium, September 4, 1858.
*d.* Uccle, near Brussels, August 1, 1905).

Professor of botany in the University of Brussels (1885-1905). Founder of the Brussels Botanical Institute (1891). *Sur la structure et les modes de fecôndation des fleurs* (1878-1881, 1905). *Essais de philosophie botanique* (1896, 1900).

**Johannes Eugenius Bülow Warming**

(*b.* Manö, Denmark, November 3, 1841).

Distinguished plant ecologist. Professor of botany and Director of the Botanic Garden of the University, Copenhagen. *Plantecækologi* (1895); *Fröplanterne* (1912).

C. Stuart Gager
A. Gundersen

## NOTICES

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Telephone: 6173 Prospect.

Mail address: Brooklyn Botanic Garden, Brooklyn, N. Y

BROOKLYN BOTANIC GARDEN

# LEAFLETS

SERIES VIII BROOKLYN, N. Y., JUNE 2, 1920 NO. 9.

## CARE OF THE LAWN

### Spring Treatment

In the spring, as soon as the coarser portions of the winter mulch, if any, have been raked off, the lawn should be rolled to press the soil closely about the grass roots and to iron out small lumps and inequalities of the surface. If a roller is not available, recourse may be had to a tamper, made from a short length of two-inch plank and a broom handle; or the soil may be compacted by beating it with the back of a spade. Either of the two latter methods, if properly done, will at least provide the operator with vigorous exercise.

At this time, to renovate bald spots, the soil of those areas that are bare or sparsely covered with grass should be scratched with an iron-toothed rake and grass seeds sown rather thickly. Cover the seeds thinly with finely-sifted soil and make firm with tamper or roller.

### Mowing

The lawn-mower should be in good condition, with working parts oiled and blades sharp, so that the grass may be cut and not mangled. The blades may be set to cut the grass at a height of two inches. The frequency, or otherwise, of mowing will depend on the rapidity with which the grass grows. In early spring, when growth is luxuriant, it may be necessary to go over the lawn twice a week; later in the season once a week is usually ample; and during periods of drought mowing may be omitted from the garden program for two or three weeks. A good rule is to mow the lawn often to obviate the necessity of removing the clippings, as these provide a valuable mulch when left on the lawn. During wet spells, when the grass grows lush and heavy, the lawn may get somewhat out of hand, and then, rather than leave a heavy mulch that may cause unsightly patches, it is advisable to rake off the clippings or catch them in a box attached to the mower.

### Watering

If the lawn has been properly prepared with a good depth of soil it is seldom necessary to water the lawn except in dry seasons. When watering is necessary it should be done before the grass turns brown, and should be thorough. Surface sprinklings are of no avail—enough water should be applied to penetrate to the moist soil below. Perhaps the best method of applying water is by means of a lawn-sprinkler, but care must be taken to allow it to play long enough to achieve the effect desired.

### Fall Treatment

It is advisable to suspend mowing operations in late fall, so as to allow the grass to pass through the winter with rather more than the regulation two inches of growth.

Opinions are divided as to the value of mulching the lawn with manure in the fall. Proponents claim that it protects the grass and provides fertility. In the vicinity of New York it is unnecessary to provide a mulch for purposes of protection, and by the use of concentrated fertilizers plant food may be added to the soil. Opponents say that it introduces weed seeds and is unsightly. It is, without doubt, unsightly, but there is little danger of introducing weed seeds if the manure is well decayed. The practice of applying fresh manure is to be condemned because it not only contains weed seeds, but is also unsightly and malodorous.

### Fertilizers

Fertility may be maintained by the use of an annual mulch of well-decayed stable manure, as already mentioned under the heading "Fall Treatment", or by the use of more concentrated fertilizers.

One of the best lawn fertilizers is ground bone applied in the fall at the rate of 10 pounds to 400 square feet. This will supply phosphorus and some nitrogen. To provide all the elements it is usually necessary to supply, this may be supplemented by a dressing of unleached hardwood ashes in the spring at the rate of 15-20 pounds to 400 square feet. When growth begins, nitrate of soda at the rate of 1-2 pounds to 400 square feet may be applied to advantage. Later in the season, about the beginning of June, another dressing of nitrate of soda may be given. This helps to promote a rich dark green color in the grass.

Another means of supplying fertility is to use a complete commercial fertilizer analyzing about 3% nitrogen, 8% phosphoric acid, and 5% potash at the rate of 10-15 pounds to 400 square feet.

When it is desired to promote the growth of Kentucky blue-grass and clover, lime at the same rate as the above may be put on during the fall.

### Weeds

The best way to eliminate weeds from the lawn is to provide conditions favorable to growth of grass. Good soil, reseeding of bare patches, frequent mowing, and keeping up fertility by application of fertilizers, all help to keep down weeds. Some perennial weeds, such as dandelion and plantain, are almost sure to occur. These should be uprooted with the help of a stout-bladed knife, or something similar, before they have a chance to flower and produce seeds. Weeds of this character show up very plainly during a dry season when the grass has become brown, owing to their ability to withstand drought and remain green. Under these circumstances it is easy to find even the small ones without hand and knee work, and advantage should be taken of the first rain that softens the soil to get them out.

Another method of eradicating these weeds is to apply gasoline or common salt to the center of the weed. The quantity to use is to be determined by experiment: it will be about a teaspoonful to a good sized weed. If too much gasoline or salt is used it may kill the grass in the vicinity; if too little is used, the weeds will not be killed. Gasoline can conveniently be applied by means of an oil can, such as is used for oiling machinery.

Some weeds of a creeping nature, such as the perennial chickweeds, can be dealt with by tearing them up, by raking with an iron-toothed rake and then sowing grass seeds. Adding fertility to the soil so as to encourage the growth of grass is a great help in overcoming these pests and also in getting rid of sheep sorrel, which is sometimes bothersome in lawns.

Crab grass is sometimes a bad weed in lawns made on poor soil insufficiently fertilized. Affected areas should be fertilized, spaded over and reseeded with good grass seed.

Very weedy lawns are usually most satisfactorily dealt with by digging or plowing them up and starting afresh.

MONTAGUE FREE.

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BROOKLYN BOTANIC GARDEN

# LEAFLETS

SERIES VIII BROOKLYN, N.Y., OCTOBER 6, 1920. No. 10.

## FAMILIES OF USEFUL PLANTS

The study of plant forms and of plant families is usually illustrated from the local floras. It may be extended in an interesting way by means of economic plants, which exhibit almost every type of structure. The following list includes some of the principal useful plants, except timber trees. A few less important ones often seen or of some special interest are added. The names are in most cases from Bailey's Cyclopedia of Horticulture.

### APETALOUS DICOTYLEDONS

WALNUT FAMILY. Pecan (*Carya Pecan*); English Walnut (*Juglans regia*); Black W. (*J. nigra*); White W. or Butternut (*J. cinerea*).

BIRCH FAMILY. Hazelnut (*Corylus* sp.)

BEECH FAMILY. Chestnut (*Castanea* sp.); Cork Oak (*Quercus Suber*).

MULBERRY FAMILY. Fig (*Ficus Carica*); Breadfruit (*Artocarpus incisa*); Hop (*Humulus Lupulus*); Hemp (*Cannabis sativa*); Mulberry (*Morus* sp.); West Indian Rubber Tree (*Castilla elastica*).

BUCKWHEAT FAMILY. Buckwheat (*Fagopyrum esculentum*); Rhubarb (*Rheum Rhaponticum*).

PEPPER FAMILY. Black, and White, Pepper (*Piper nigrum*).

PIGWEED FAMILY. Beet (*Beta vulgaris*) and its varieties, Swiss Chard and Sugar Beet; Spinach (*Spinacea oleracea*).

CARPETWEED FAMILY. New Zealand Spinach (*Tetragonia expansa*).

### POLYPETALOUS DICOTYLEDONS

CUSTARD APPLE FAMILY. Custard Apple, Sweet-sop, Soursop, Cherimoya (*Anona* sps.)

NUTMEG FAMILY. Nutmeg (*Myristica fragrans*).

LAUREL FAMILY. Camphor (*Cinnamomum Camphora*); Cinnamon (*Cinnamomum zeylanicum*); Avocado Pear (*Persea gratissima*); Laurel (*Laurus nobilis*).

POPPY FAMILY. Poppy (*Papaver somniferum*).

MUSTARD FAMILY. Cabbage (*Brassica oleracea*) and its varieties, Kale, Cauliflower, and Brussels Sprouts; Turnip (*B. Rapa*); Rutabaga (*B. campestris*); Radish (*Raphanus sativus*); Horseradish (*Radicula Armoracia*); Water-cress (*R. officinalis*); Mustard (*Brassica nigra*).

SAXIFRAGE FAMILY. Red currant (*Ribes vulgare*); Black C. (*R. nigrum*); Gooseberry (*R. Grossularia*).

ROSE FAMILY. Strawberry (*Fragaria* sp.); Raspberry, Loganberry, Salmonberry, Thimbleberry, Whortleberry, Blackberry, Dewberry (*Rubus* sps.)

APPLE FAMILY. Apple (*Malus pumila*); Pear (*Pyrus communis*); Quince (*Cydonia oblonga*); Loquat (*Eriobotrya japonica*); Juneberry (*Amelanchier* sps.)

PLUM FAMILY. Plum (*Prunus domestica* and others); Peach and Nectarine (*P. Persica*); Apricot (*P. Armeniaca*); Sweet Cherry (*P. Avium*); Sour C. (*P. Cerasus*); Almond (*P. Amygdalus*).

PEA FAMILY. Peanut (*Arachis hypogaea*); Pea (*Pisum sativum*); Bean (*Phaseolus vulgaris*); Lima Bean (*P. lunatus*); Soy Bean (*Glycine Soja*); Lentil (*Lens esculenta*); Chick Pea (*Cicer arientum*); Cow Pea (*Vigna sinensis*); Horse Bean (*Vicia Faba*); Indigo (*Indigofera tinctoria*); Licorice (*Glycyrrhiza glabra*); Tamarind (*Tamarindus indica*).

FLAX FAMILY. Flax (*Linum usitatissimum*).

RUE FAMILY. Citron (*Citrus medica*); Lemon (*C. Limonia*); Lime (*C. aurantifolia*); Grapefruit (*C. grandis*); Orange (*C. sinensis*); Kumquat (*Fortunella* sp.); Rue (*Ruta graveolens*).

TORCHWOOD FAMILY. Peli-nut (*Canarium luzonicum*).

MAHOGANY FAMILY. Mahogany (*Swietenia Mahogani*).

SPURGE FAMILY. Castor Bean (*Ricinus communis*); Tapioca (*Manihot utilissima*); Rubber Tree (*Hevea brasiliensis*).

SUMACH FAMILY. Pistachio Nut (*Pistacia vera*); Cashew-nut (*Anacardium occidentale*); Mango (*Mangifera indica*); Varnish Tree (*Rhus verniciflua*).

SOAPBERRY FAMILY. Akee (*Blighia sapida*); Lichi (*Nephelium lichi*).

BUCKTHORN FAMILY. Date Plum or Jujube (*Zizyphus* sp.)

GRAPE FAMILY. Grape (*Vitis vinifera* and *V. Labrusca*).

LINDEN FAMILY. Jute (*Corchorus* sps.)

MALLOW FAMILY. Cotton (*Gossypium hirsutum*); Sea Island Cotton (*G. barbadense*); Okra (*Hibiscus esculentus*).

SILK COTTON FAMILY. Balsa Wood (*Ochroma lagopus*); Durian (*Durio zibethinus*).

CACAO FAMILY. Cacao (*Theobroma Cacao*).

TEA FAMILY. Tea (*Thea sinensis*).

ST. JOHN'S WORT FAMILY. Mammee Apple (*Mammea americana*); Mangosteen (*Garcinia Magnostana*).

Papaw Family. Papaw (*Carica Papaya*).

Pomegranate Family. Pomegranate (*Punica granatum*).

Brazil Nut Family. Brazil Nut (*Bertholletia excelsa*); Paradise Nut (*Lecythis* sp.)

Myrtle Family. Cloves (*Eugenia caryophyllata*); Guava (*Psidium Guajava*).

Carrot Family. Carrot (*Daucus Carota*); Parsnip (*Pastinaca sativa*); Celery (*Apium graveolens*); Parsley (*Petroselinum hortense*); Caraway (*Carum Carvi*); Anise (*Pimpinella anisum*); Dill (*Anethum graveolens*); Coriander (*Coriandrum sativum*).

## SYMPETALOUS DICOTYLEDONS

Heath Family. Blueberry (*Vaccinium* sp.); Huckleberry (*Gaylussacia* sp.); Cranberry (*Vaccinium macrocarpon*).

Sapota Family. Sapodilla (*Achras Sapota*); Mammee Sapota (*Lucuma mammosa*).

Ebony Family. Persimmon (*Diospyros virginiana*); Japanese Persimmon (*D. Kaki*).

Olive Family. Olive (*Olea europaea*).

Morning Glory Family. Sweet Potato (*Ipomoea Batatas*).

Mint Family. Peppermint (*Mentha piperita*); Spearmint (*M. spicata*); Pennyroyal (*M. Pulegium*).

Potato Family. Potato (*Solanum tuberosum*); Egg Plant (*S. melongena*); Tomato (*Lycopersicum esculentum*); Ground Cherry (*Physalis* sp.); Chile Pepper (*Capsicum annuum*); Tobacco (*Nicotiana Tabacum*).

Madder Family. Coffee (*Coffea arabica*); Quinine (*Cinchona* sp.)

Valerian Family. Corn Salad (*Valerianella olitoria*).

Gourd Family. Watermelon (*Citrullus vulgaris*); Muskmelon (*Cucumis Melo*); Cucumber (*C. sativus*); Pumpkin (*Cucurbita Pepo*); Squash (*C. maxima*).

Composite Family. Globe Artichoke (*Cynara Cardunculus*); Jerusalem A. (*Helianthus tuberosus*).

Chicory Family. Lettuce (*Lactuca sativa*); Dandelion (*Taraxacum officinale*); Endive (*Cichorium Endivia*); Chicory (*C. Intybus*); Oyster Plant or Salsify (*Tragopogon porrifolius*).

## MONOCOTYLEDONS

Palm Family. Date Palm (*Phoenix dactylifera*); Coconut P. (*Cocos nucifera*); Sago P. (*Metroxylon* sp.); Sugar P. (*Phoenix sylvestris* and *Arenga saccharifera*); Oil P. (*Elaeis guineensis* and others); Vegetable Ivory (*Phytelephas* sp.)

Grass Family. Wheat (*Triticum aestivum*); Rye (*Secale cereale*); Barley (*Hordeum sativum*); Oats (*Avena sativa*); Corn (*Zea Mays*) and varieties Sweet Corn and Pop Corn; Rice (*Oryza*

*sativa*); Bamboo (*Bambusa arundinacea*); Sugar Cane (*Saccharum officinarum*).

Pineapple Family. Pineapple (*Ananas sativus*).

Lily Family. Asparagus (*A. officinalis*); Onion (*Allium Cepa*); Chives (*A. Schoenoprasum*); Leek (*A. Porrum*); Garlic (*A. sativum*).

Amaryllis Family. Sisal Hemp (*Agave rigida*).

Yam Family. Yam (*Dioscorea Batatas*).

Banana Family. Banana (*Musa sapientum*); Manila Hemp (*M. textilis*).

Ginger Family. Ginger (*Zingiber officinale*); Cardamon (*Elettaria Cardamomum* and *Amomum Cardamon*).

Arrowroot Family. Arrowroot (*Maranta arundinacea* and others).

Orchid Family. Vanilla (*Vanilla planifolia*).

Margaret Chapin.

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## NOTICES

The Garden is open free to the public daily, from 8 a. m. until dark; on Sundays and holidays at 10 a m. The Laboratory Building, containing the library, herbarium, and offices, is open daily (except Sundays), from 9 a. m. until 5 p. m. (Saturdays, 9-12). The Conservatories are open April 1–October 1, 10 a. m.–4:30 p. m. (Sundays, 2-4:30); October 1–April 1, 10 a. m.–4 p. m. (Sundays, 2-4).

The Garden may be reached by Flatbush Ave. trolley to Empire Boulevard; Franklin Ave., Lorimer St., and Tompkins Ave. trolleys to Washington Ave.; St. John's Place and Rogers Ave. trolleys to Sterling Place; Vanderbilt Ave., Sixteenth Ave., Union St., Greenpoint, and Smith St. trolleys to Prospect Park Plaza and Union St., and Brighton Beach elevated to Botanic Garden Station.

A docent will meet parties by appointment and conduct them through the Garden. This service is free to members of the Botanic Garden and to teachers with classes; to others there is a nominal charge of 25 cents an hour for parties of less than three, and 10 cents a person per hour for parties of three or more.

Subscription for Leaflets fifty cents a series (comprising about fourteen numbers); free to members of the Botanic Garden and to teachers.

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